Overview of Radiation Concepts & Regulatory Structure

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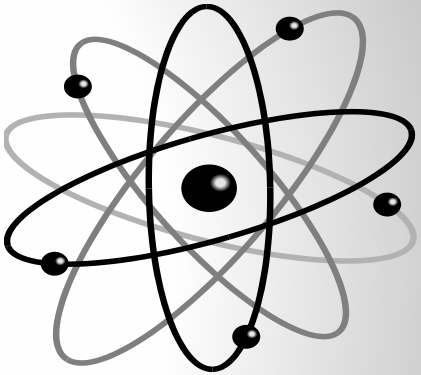
Types of Ionizing Radiation

Radioactive materials will emit both ionizing particles and waves during decay



- Particles
  - Alpha particles
  - Beta particles
  - Neutrons
- Energy waves or “rays”
  - Gamma rays
  - X-rays

These types of ionizing radiation interact with matter by depositing energy when they are moving

Exposure, Contamination, Dose

Contamination: Contamination results when a radioactive material (a gas, liquid, or solid) is somewhere you don't want it

Exposure: Radiation exposure occurs when the body absorbs radiation from an external source

Dose: Measurement of radiation energy deposited in tissue

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Units of Measure

Units

Exposure\Dose = Roentgen (“R”)

1 “R” is a relatively large radiation exposure

Exposure measured in smaller fractions of an “R”

- milliR (mR) (1/1,000 of R)
- microR (µR) (1/1,000,000,000 of R)

Typical background exposure rates are <u>5 to 10 µR/hr</u>

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Units of Measure

Units (Cont.)

Radioactivity = Curie (Ci)

1 “Ci” of radioactivity is considered a large amount

Radioactivity measured in smaller fractions of a Curie

- pico Curie (pCi) (i.e. 1/1,000,000,000,000 of Curie)

The amount of radioactive material present = amount of radioactivity found in a gram or liter of the substance …..(pCi/g), or (pCi/L)

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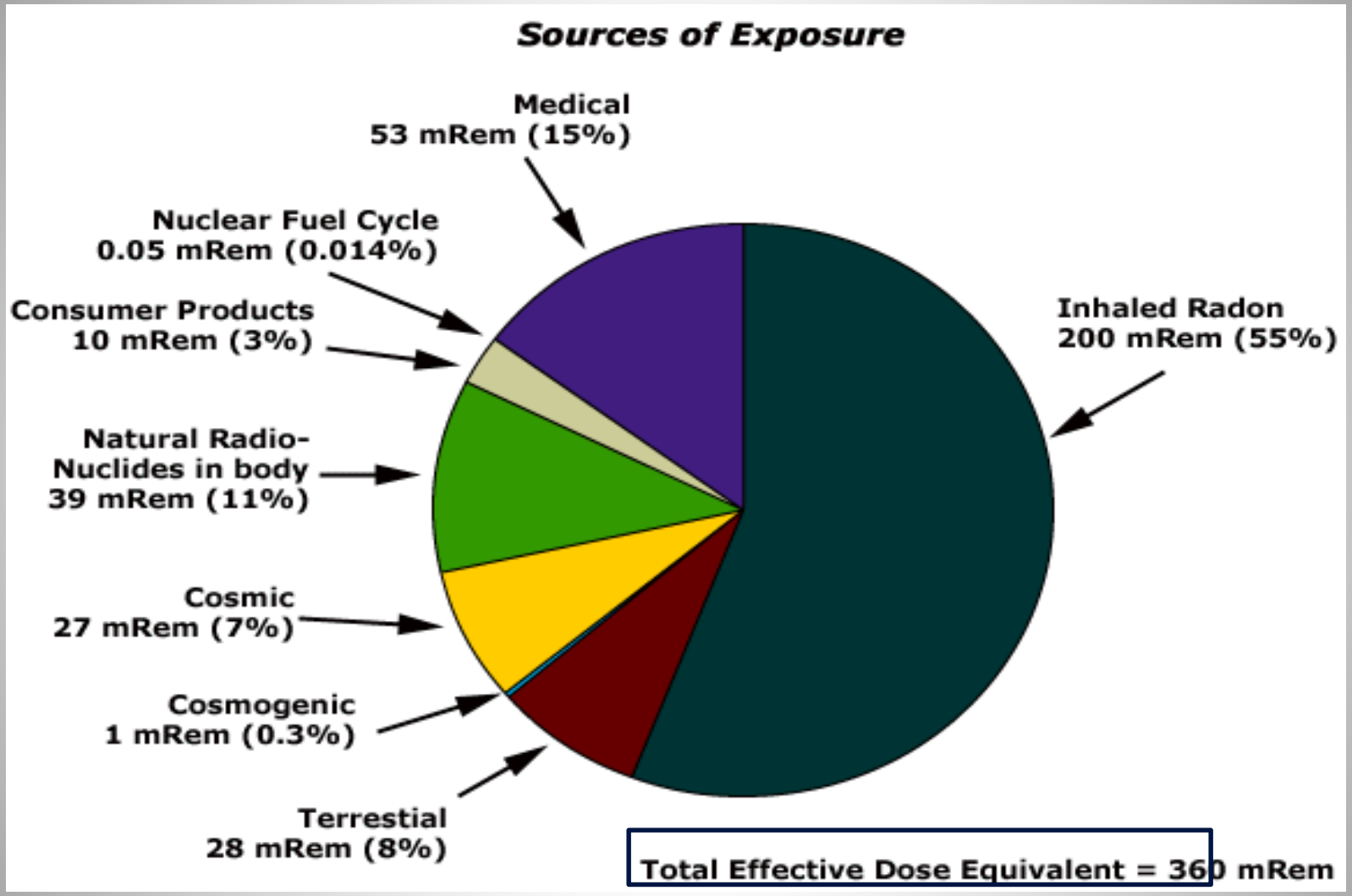
Sources of Radiation Exposure



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Doses in Perspective

Source	Exposure
Average U.S. annual exposure – all sources	360 mR/year
Average U.S. annual exposure – including medical/diagnostic	720 mR/year
Chest X-ray	5-10 mR
CT Scan	1,000 – 2,000 mR
Annual dose limit for radiation workers	5,000 mR/year
Emergency limit (saving major property)	10,000 mR/event
Emergency limit (saving life)	25,000 mR/event
Biological health effects observable (blood changes)	50,000 mR
Lethal radiation dose (50% lethality)	450,000 mR

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TENORM vs Radioactive Wastes

NORM - Naturally Occurring Radioactive Materials

Natural radioactivity is present in trace amounts in the earth's crust and waters.

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TENORM vs Radioactive Wastes

TENORM – Technologically Enhanced Naturally Occurring Radioactive Materials

NORM containing material which has been impacted or utilized by one or more industrial process.

TENORM wastes may have higher conc. of radionuclides e.g. uranium, thorium, and progenies Radium-226 and Radium-228

May subject people to higher exposure\dose levels.

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TENORM vs Radioactive Wastes

Radioactive Wastes

Wastes which contain radioactive materials

Typically by-products of nuclear power generation (LLRW, ILRW, HLRW) or

Other processes which result in fission or splitting of an atom

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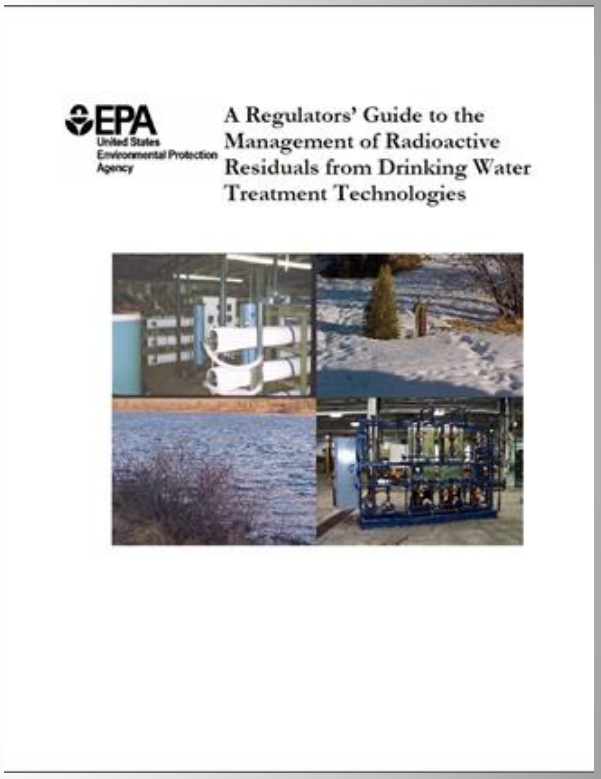
Exposure Pathways

How, specifically, does TENORM present an exposure concern?

- Inhalation, ingestion, direct exposure

How, specifically, does TENORM present an exposure concern to the general public?

- Inappropriate disposal (illegal dumping)
- Recycling of contaminated components
- Liquid discharges



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Exposure Pathways

Mitigating External Radiation

TIME – minimize time spent near a source to minimize radiation exposure

DISTANCE – radiation dose rates fall off rapidly with distance; increase the distance between you and a source to minimize radiation exposure

SHIELDING – put something between you and the source to minimize radiation exposure

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Exposure Pathways

Mitigating Inhalation, Ingestion, & Exposure

Proper and safe disposal – Modernized landfill design, construction, and operations……monitoring, reporting, waste screening, daily cover.

Training – Limit exposure pathways by recognizing hazards and avoiding them.

Prevent dispersal – Covered during transport, dust control, etc.

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Existing Regulatory Requirements
(ARM 17.50 Subchapters 5-13)

Landfill Siting
- *Location criteria and restrictions*

Waste Group/Class
- *TENORM is Group II waste = Class II facility*

Landfill Design and Construction
- *Must be protective of uppermost aquifer*
- *Design must be approved by P.E. and DEQ*
- *Must submit CQA/CQC plans and reports*

Landfill Operation
- *Hours, dust control, daily cover, etc…*

Landfill Monitoring
- *Ground water sampled at least twice per year*
- *Air monitoring new for TENORM facilities*

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Existing Regulatory Requirements
(ARM 17.50 Subchapters 5-13)

Storm water control

- *Must control run-on and run-off from 24-hour, 25-year event*
- *MPDES permit required for discharge*
- *Permit requires storm water analysis*

Leachate Collection and Removal System

- *Maintain less than one-foot leachate on liner*
- *Leachate management requirements*

Financial Assurance and Closure/Post-closure Care

- *FA funded prior to waste acceptance*
- *Post-closure monitoring and care requirements*

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Conclusions

The goal for the proposed TENORM rules is to protect human health and the environment by:

- Establishing TENORM-specific standards to minimize exposure to humans and the environment:
  - Waste Characterization
  - Waste Acceptance Criteria
    - ✓ Dual waste acceptance criteria
      - ➢ Dose\exposure limits and concentration limits
  - Waste Screening
  - Additional ground water and air monitoring
  - Spill reporting

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Reference Documents

"Radiation: Facts, Risks, and Realities", US EPA. EPA-402-K-10-008 April 2012

"A System's Guide to the Management of Radioactive Residuals from Drinking Water Treatment Technologies" EPA 816-F-06-012 August 2006

"Suggested Guidelines for the Disposal of Drinking Water Treatment Wastes Containing Naturally Occurring Radionuclides" EPA July 1990

"Radionuclides Notice of Data Availability Technical Support Document" EPA March 2000

"Potential Radiological Doses Associated with the Disposal of Petroleum Industry NORM via Landspreading" Argonne National Laboratory DOE/BC/W-31-109-ENG-38-5 December 1998


Q&A